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# Performance in the military of general educational development certificate personnel.

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PERFORMANCE IN THE MILITARY OF
GENERAL EDUCATIONAL DEVELOPMENT
CERTIFICATE PERSONNEL

Erkut Ersoy

# NAVAL POSTGRADUATE SCHOOL
## Monterey, California

# THESIS

PERFORMANCE IN THE MILITARY OF
GENERAL EDUCATIONAL DEVELOPMENT
CERTIFICATE PERSONNEL

by

Erkut Ersoy

December 1979

Thesis Advisor:                    Richard S. Elster

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| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1. REPORT NUMBER | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>Performance in the Military of General Educational Development Certificate Personnel | | 5. TYPE OF REPORT & PERIOD COVERED<br>Master's Thesis; December 1979 |
| | | 6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s)<br>Erkut Ersoy | | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Naval Postgraduate School<br>Monterey, California 93940 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>Naval Postgraduate School<br>Monterey, California 93940 | | 12. REPORT DATE<br>December 1979 |
| | | 13. NUMBER OF PAGES<br>65 |
| 14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office)<br>Naval Postgraduate School<br>Monterey, California 93940 | | 15. SECURITY CLASS. (of this report)<br>Unclassified |
| | | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Attrition; Enlisted Personnel; Linear Regression Analysis; Manpower; Personnel Retention; Personnel Selection; Predictions; Recruits.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The objective of this study is to analyze adjustment to the military of a specific educational group: GED (General Educational Development) holders. This study also compares members of the GED and other educational groups on selected characteristics. Finally, this study analyzes first-term loss rates for these groups by applying a linear-group prediction model.

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1 JAN 73
(Page 1)    S/N 0102-014-6601

20.    (Continued)

        Hopefully, this thesis will help military policy makers and
recruiters make decisions which will lower first-term personnel
loss rates.

PERFORMANCE IN THE MILITARY OF GENERAL EDUCATIONAL
DEVELOPMENT CERTIFICATE PERSONNEL


by

Erkut Ersoy
Lieutenant Junior Grade, Turkish Navy


Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT


from the

NAVAL POSTGRADUATE SCHOOL
December 1979

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# I. OBJECTIVE

Since the all-volunteer force (AVF) became effective on 1 July 1973, the military services have experienced varying degrees of success in reaching their recruiting goals. However, attrition is a major problem. It is causing higher budget costs and creating manpower shortfalls within the services. Besides that problem, manpower predictions are indicating a sharp decline in the 18-21 years old age cohort in the 1980's. Unless the unemployment rate is very high, or military pay increases dramatically, etc., the military services will have difficulties in attracting enough manpower under the AVF. Manpower planners should know what types of personnel have the lowest attrition probabilities.

The objective of this study is to analyze adjustment to the military of a specific educational group: GED (General Educational Development) holders. This study also compares members of the GED and other educational groups on selected characteristics. Finally, this study analyzes first-term loss rates for these groups by applying a linear-group prediction model.

Hopefully, this thesis will help military policy makers and recruiters make decisions which will lower first-term personnel loss rates.

## II.  BACKGROUND

### A.  RECRUITING

With the advent of the AVF, all services began to broaden and intensify their recruiting efforts, and the role of the military recruiter changed significantly.  Recruiting accomplishment was based on market supply as well as on accession requirements.

The major initial concern was with the Army's ability to recruit for the combat arms.  In June 1972, a combat arms bonus had been authorized by Congress.  That enabled the Army to maintain an average monthly combat arms accession total of 3000 through FY 1973.  Two-thirds of the Army's combat arms enlistments were bonus enlistees.

Figure 1 shows that real resources spent on advertising, enlistment bonuses and recruiting, collectively, have more than doubled from FY 1970 through FY 1975.

### B.  TRENDS IN QUALITY OF ACCESSIONS

The quality of the force has typically been measured in terms of mental test scores and educational achievement. Quality of officers has increased [Ref. 3], but major concern has concentrated on the quality of enlisted accessions.

#### 1.  Mental Categories

The mental abilities of military accessions are measured by scores received on the Armed Services Vocational

ALL SERVICES
# ENLISTED RECRUITING COSTS
## (1977 DOLLARS)
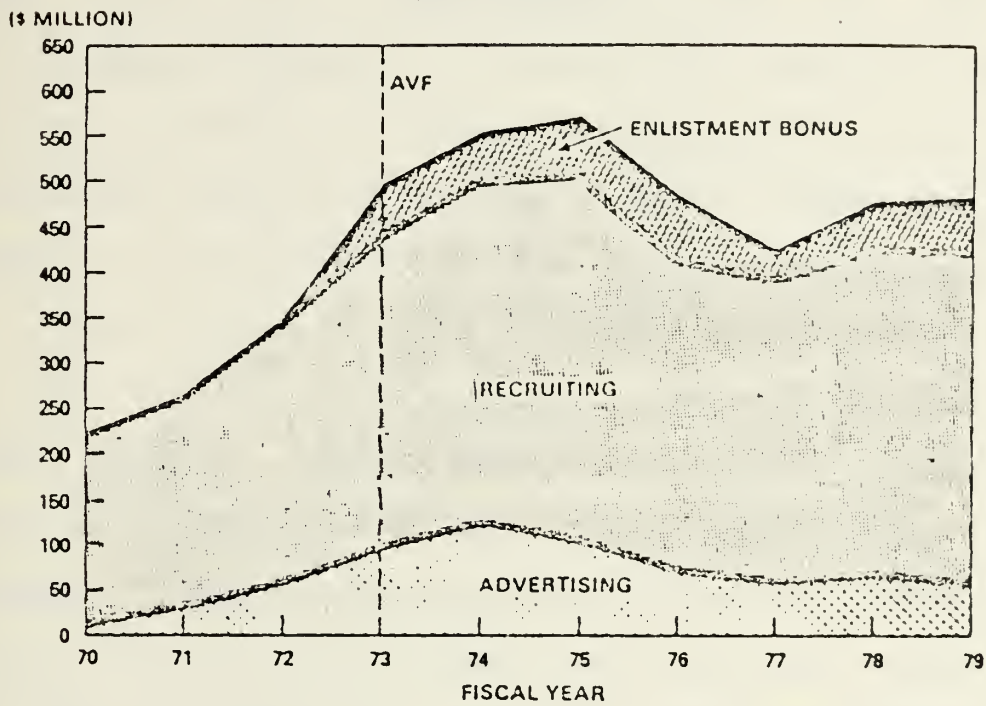


FIGURE 1.


SOURCE:   Ref. [3]

Aptitude Battery (ASVAB). Several of the ASVAB scores are
then converted to a standardized test score called the Armed
Forces Qualification Test (AFQT). Based on AFQT percentile
scores, enlistees are classified into one of five mental cate-
gories with Category I being the highest. The average AFQT
score is 50, which divides mental Category III. The top 8%
are in mental Category I. The next 27%, from 65 to 92, are
in mental Category II. Mental Category III is from 31 to 64
and mental Category IV is from 10 to 30. Those scoring in
Category V are disqualified from military enlistment. [Ref. 3]

Figure 2 shows the trends for NPS enlisted accessions. In
FY 1964, one out of every seven active force enlistees was in
mental group IV. During the AVF years this percentage has
declined steadily; by FY 1977 it was one in twenty. Mental
Category IV accessions are easier to recruit, but are more
likely to require additional time to complete training than
do those in Categories I through II (and have higher losses
than other accessions with the same educational level). [Ref.
3] Training costs to replace losses must be balanced against
the increased recruiting costs associated with recruiting in-
dividuals from the higher mental categories.

2. Educational Levels

While the percentage of accessions who are highschool
graduates has only slightly increased over the pre-Vietnam
period, the percentage of the total active enlisted force
with a highschool education (including GED certificates) has
reached the highest level ever recorded, as shown in Figure 3.

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Active Duty NPS Enlisted Accessions by Mental Category

**MENTAL CATEGORY I & II**
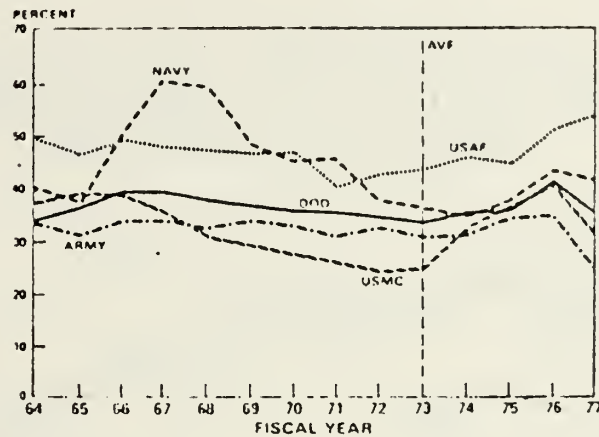


**MENTAL CATEGORY III**
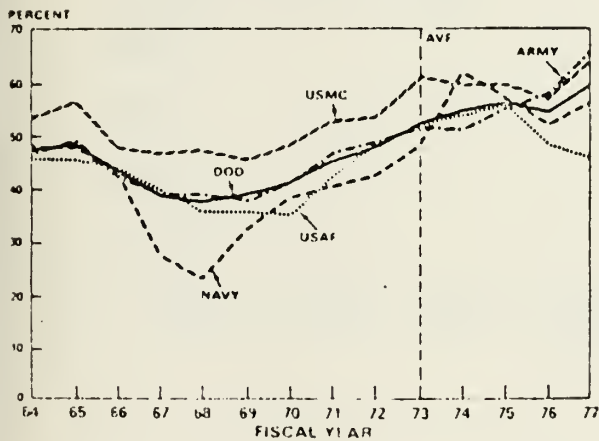


**MENTAL CATEGORY IV**
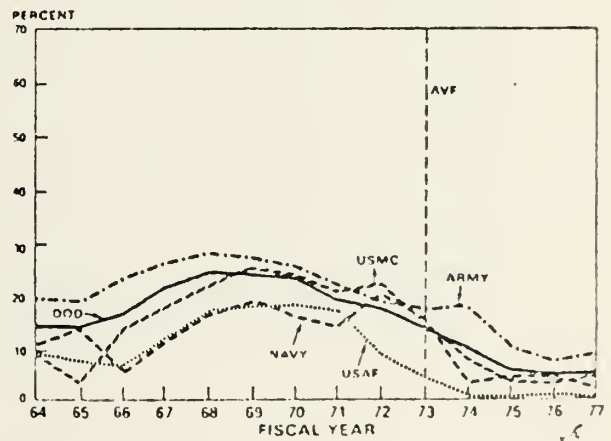


FIGURE 2.

SOURCE:   Ref. [3]

HIGH SCHOOL GRADUATES AS A
PERCENTAGE OF TOTAL ACTIVE
ENLISTED PERSONNEL
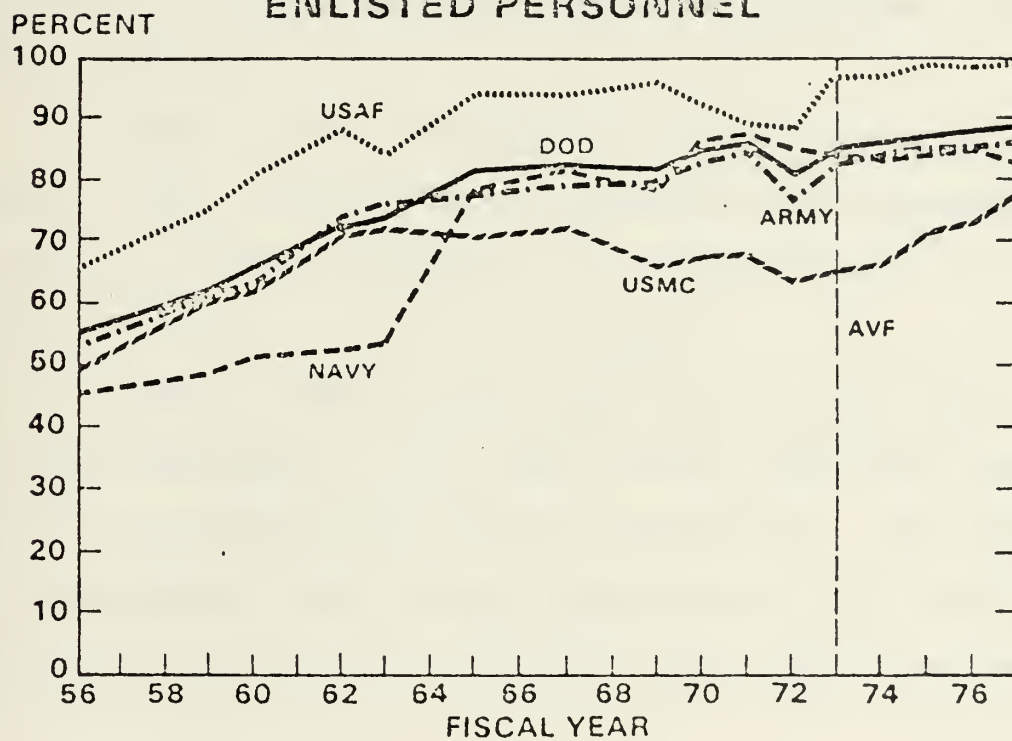
FIGURE 3.

In December 1977, 88% of the active enlisted force had a highschool education or GED, compared to 81% in December 1972, the time of the last draft call, and about 75% during 1964 the last year before the Vietnam draft increases.

3. Changes in Representativeness of force

During the debate on the AVF in the early 1970's, there was concern that under the AVF the Armed Forces would become an Army of the black and poor, primarily recruited from the South. [Ref. 3]

Figure 4 shows the trends of black officer accessions since FY 1964. Black officer accessions have increased from 1.6% of all officer accessions in FY 1972 prior to the AVF to 5.4% in FY 1977.

Figure 5 shows the Enlisted Force trends since FY 1964 in black accessions. In FY 1964, blacks comprised about 10% of DoD's NPS active duty enlisted accessions. The number of black accessions under the AVF has grown so that blacks represent almost 30% of total active-duty Army NPS accessions.

## BLACKS AS A PERCENTAGE OF TOTAL
## ACTIVE DUTY OFFICER ACCESSIONS
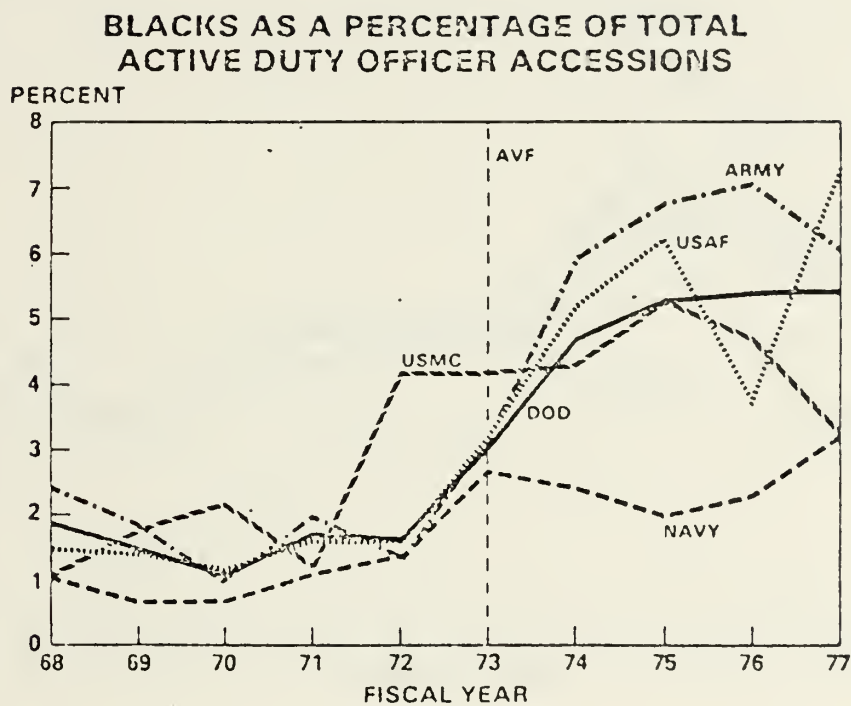


FIGURE 4

SOURCE:   Ref [3]

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# BLACKS AS A PERCENTAGE OF TOTAL NPS ACTIVE DUTY ENLISTED ACCESSIONS
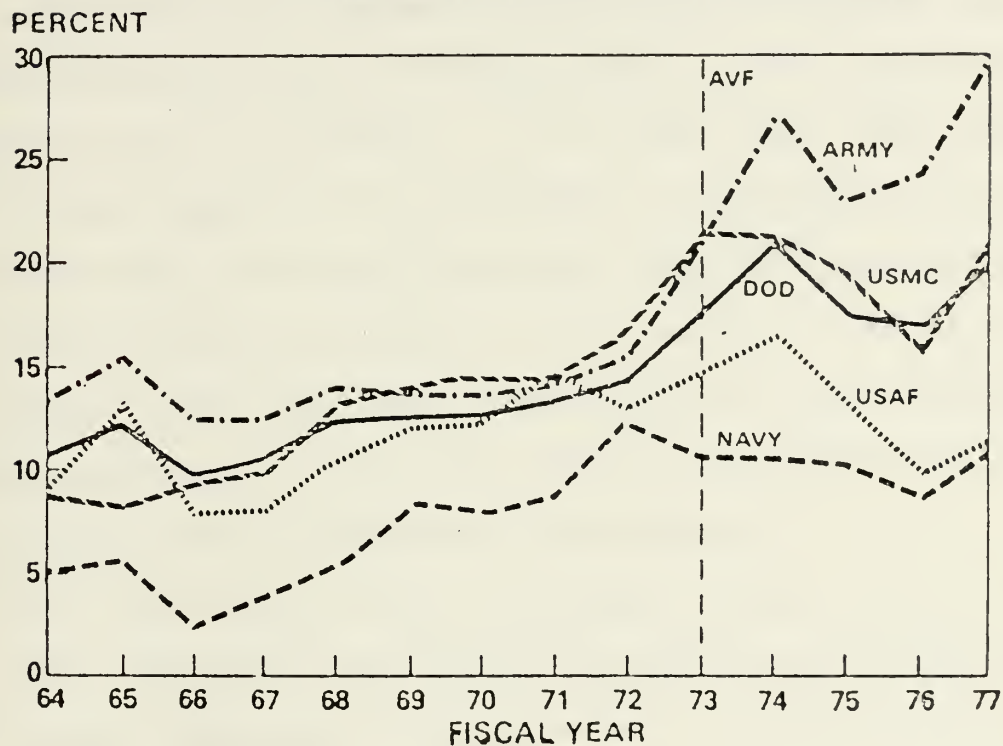


FIGURE   5

SOURCE:   Ref [3]

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# III.  ATTRITION

It is true that more military personnel are being released before completion of their initial enlistment obligation now than during the draft.  [Ref. 4]  This attrition is expensive and disruptive, and represents a serious manpower dilemma.  In an all-volunteer force, it often does not make sense to force people to stay in a service.  It is known that such practices may be more expensive than releasing troublemakers early in their military career, and recruiting and training replacements. [Ref.4]

Attrition must be viewed in the context of its costs and the challenges to AVF recruiting represented by both a declining youth population in the 1980's and the likelihood of an improving economy making recruiting more difficult.

The future active force recruiting picture appears challenging.  The declining youth population projected for the 1980's has focused attention on the question of the viability of the volunteer force during the next decade.  The main question appears to center on the Services' ability to recruit in the face of a declining youth population base, and possible lower unemployment rates in the 1980's.

It is known that the number of 18-year-old men in the United States will decline after 1980.  By 1985, the number of 18-year-old males will have declined gradually by about one-third of a million, or 15% less than in 1976.  By 1992 the decline will have totalled more than one-half million, or 25%.  Figure 6 shows this decline.

PROJECTION OF 17-21 YEAR OLD MALE POPULATION
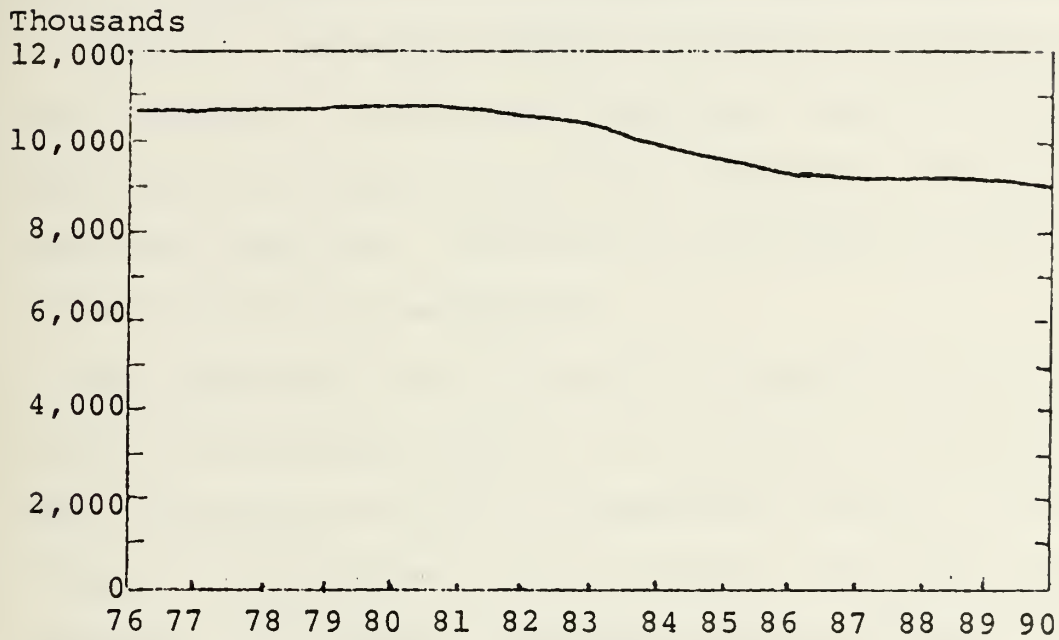


FIGURE 6.

SOURCE:  Ref. [3]

More intense competition for highschool diploma graduates
is likely. Highschool graduates are the preferred recruits.
Nongraduates, other factors such as AFQT score being equal, are
twice as likely to be separated early as are highschool graduates.
(See Table XIII of this thesis.) Accession quality is an impor-
tant determinant of first term attrition, but it takes more re-
cruiting resources to recruit quality diploma graduates. [Ref.4]

Clearly, recruiting quality enlistees is becoming marginally
very expensive, and this will increase dramatically unless the
requirement for high quality male accessions can be reduced as
the market declines. Reduction in attrition is one management
option that must be addressed.

The sustainability of the AVF in the face of the declining
market is obviously related to the Services' ability to imple-
ment effectively some mix of management options to reduce male
accession requirements and/or increase supply by, for instance,
increased use of women, increased use of civilians, increased
use of career-force personnel, improved recruiting efficiency,
lower mental/physical standards and, very importantly, reduced
first-term attrition.

Under these circumstances, one of the most promising ap-
proaches would be to look into personnel selection and attempt
to find new pre-service predictors to reduce attrition, and to
identify what type of people the Services should try to attract.

In the following chapter, data from GED certificate holders
will be investigated.

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## IV.  ANALYSIS OF THE G.E.D. GROUP

A.  WHAT IS THE GED

The tests of General Educational Development (G.E.D.) were developed in 1942 by the United States Armed Forces Institute in order to provide the veterans of World War II a means to readjust to civilian life as they resumed their educational and vocational plans.  [Ref. 13]  The GED tests provide the non-highschool graduate an opportunity to obtain a highschool equivalency certificate which is generally accepted as a regular highschool diploma by institutions of higher education, business organizations and the Civil Service Commission.  [Ref. 14]

The GED test battery consists of five tests covering the areas of english, social studies, natural sciences, literature, and mathematics.  The tests are designed to measure knowledge acquired in the typical general educational programs offered in secondary schools.  Rather than emphasizing knowledge of details, the tests concentrate on the ability to generalize concepts and ideas, to comprehend exactly and to evaluate critically.  The tests also seek to determine the extent to which informal educational experiences have had a long-term impact equivalent to that which might be the result of a good formal education.  Thus, by means of these tests, individuals who have not formally completed their secondary school education may be certified as having the equivalent of a highschool diploma.  [Ref. 13]

B. GED TESTS AS PREDICTORS OF SCHOLASTIC SUCCESS

Although GED tests are not designed for such prediction
purposes, some studies have shown that they can be used as pre-
dictors of later scholastic success.

A study of Yale students by Crawford and Burnham was de-
signed to determine the value of GED test scores in predicting the
scholastic success of freshmen. [Ref. 1]  A representative samp-
ling of the entire class, veterans and non-veterans, was used
in this study with scores of the College Entrance Examination
Board Tests (CEEB) used to select the sample.  Total standard
scores on the GED tests were found to correlate with first term
freshmen's marks with a correlation coefficient of .56 as com-
pared to a coefficient of .53 between CEEB total scores and first-
term freshmen's marks.  This coefficient (.56) was higher than
that of any of the GED tests used single.  Table I shows these
relationships.  [Ref. 11]

TABLE I.

The Relationships of GED test scores to Average First-Term
Marks for YALE Freshmen, N = 135

|  | M | S.D | R |
| --- | --- | --- | --- |
| GED Total.......... | 270.4 | 20.9 | .56 |
| GED I .............. | 62.9 | 6.2 | .51 |
| GED II ............. | 69.5 | 7.7 | .50 |
| GED III............. | 73.3 | 5.5 | .36 |
| GED IV ............. | 64.7 | 6.1 | .41 |

Another study based upon service veterans who were students in the General College of the University of Minnesota showed similar results.  Table II shows the results of the Minnesota study.  [Ref. 11]

TABLE II

Relationship between Honor-Point Ratio and the GED
Tests For Veterans at Minnesota

|  | N | Mean | S.D | r |
|---|---|---|---|---|
| GED Total ........ | 56 | 218.62 | 25.27 | .72 |
| GED I ............ | 58 | 48.28 | 6.80 | .51 |
| GED II ........... | 59 | 57.82 | 8.63 | .60 |
| GED III .......... | 59 | 57.99 | 8.76 | .55 |
| GED IV ........... | 58 | 53.40 | 7.72 | .56 |

The honor-point ratios of the sample are based upon the first-term courses in General College and ranged from 3.0 to -.43, with a mean and standard deviation of 1.36 and .81 respectively.  (Three honor points are given for a mark A, with other values ranging to -1.0 for a mark of F.)

Although the GED tests were not designed as predictors of scholastic success, it appears they might serve this capacity quite well.

C.  GED TESTS AS PREDICTORS OF EDUCATIONAL LEVEL AND MENTAL ABILITY

In this section, the following two topics will be addressed: (1) to what extent does the GED differentiate among people having varying amounts of highschool education? and (2) what is the relationship of GED test scores to general mental ability, as measured by the Army General Classification Test?

The data consisted of the GED scores of 304 male enlisted personnel of the Army who had been administered the GED Test upon entry into the service. These inductees, whose residences were scattered throughout the entire country, had completed varying amounts of schooling (7-11 years) and, because they were tested immediately upon induction, had received no further education beyond their last year of school.

Table III shows the means and standard deviations for each of the five GED subtests according to the last year of school completed.

It will be observed in Table III that for the most part there is a graduate increase in mean score at each educational level, although the differences are small and there is considerable overlap, as can be seen by examining the standard deviations and the means. These differences are certainly too small to permit individual diagnosis, and in some cases do not even bring out group differences. Three tests (Social Studies, Natural Sciences, Literary Materials) fail to provide the expected discrimination between the 8th and 9th grade levels.

At the time of their induction, the same recruits were also given the military form of the Army General Classification Test [Ref. 2]. This test was designed to measure "general learning ability" and has shown its greatest validity in predicting success in various kinds of military training. The test contains three types of speeded items (vocabulary, arithmetic, and block counting) to measure verbal, numerical reasoning and spatial factors, respectively. These items were employed by the test's

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TABLE III.

MEANS AND STANDARD DEVIATIONS OF 304 ARMY ENLISTED PERSONNEL ON
SUBTESTS OF THE GENERAL EDUCATIONAL DEVELOPMENT TEST ACCORDING
TO LAST SCHOOL GRADE COMPLETED

| Grade | N | Expression | | Soc. Stud. | | Nat. Sci. | | Lit. Mat. | | Math. Abil. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | SD | M | SD | M | SD | M | SD | M | SD |
| 7th | 25 | 35.14 | 4.23 | 42.00 | 7.64 | 45.00 | 9.18 | 43.83 | 5.95 | 42.50 | 6.73 |
| 8th | 65 | 39.93 | 7.73 | 48.50 | 8.93 | 51.64 | 8.22 | 46.08 | 8.37 | 46.08 | 8.37 |
| 9th | 65 | 41.10 | 4.68 | 48.02 | 7.43 | 51.09 | 6.70 | 45.72 | 6.88 | 47.76 | 6.99 |
| 10th | 74 | 46.03 | 8.41 | 50.10 | 9.54 | 52.18 | 8.55 | 49.40 | 8.84 | 49.19 | 8.68 |
| 11th | 75 | 45.66 | 9.10 | 53.13 | 8.68 | 55.46 | 7.40 | 53.40 | 8.20 | 50.74 | 7.76 |

SOURCE:   Ref. [8]

developers in an effort to avoid test content which would be greatly influenced by schooling beyond the first few grades. [Ref. 8] Despite this, the AGCT correlates .73 with the highest school grade completed. It has been claimed, however, that this relationship does not mean that the test is loaded with specific scholastic content, but rather that the school level reached acts as a screening device in the same manner as does the AGCT. [Ref. 15] Table IV shows the correlation of each GED subtest with the AGCT.

These coefficients indicate a substantial relationship between the GED and the AGCT, a finding which is in agreement with the studies previously cited, where other measures of mental ability were used. In Table IV the relationship is lowest for the Correctness and Effectiveness of Expression subtest and highest for the Social Studies and Literary Materials subtests. The latter relationship is somewhat surprising in view of the item content of the AGCT. In any case, if we accept the claim that the AGCT does not measure academic achievement, it appears that the GED shares a substantial amount of variance with the AGCT variance attributable to non-academic factors.

Considering both parts of this study jointly, the conclusion seems clear that there is limited evidence for the validity of the GED Highschool Level as a measure of educational development, apart from mental ability.

D.  AGE OF MILITARY ENLISTED MEN AS FACTORS IN TESTS OF GENERAL
    EDUCATIONAL DEVELOPMENT

Is chronological age a factor in the scores on tests of factual knowledge, skills and interpretive reading? Does

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TABLE IV.

CORRELATION OF GED SUBTESTS WITH ARMY GENERAL CLASSIFI-
CATION TEST (N = 304)

| GED SUBTEST | r WITH AGCT |
|---|---|
| Expression | .52 |
| Social Studies | .64 |
| Natural Sciences | .60 |
| Literary Materials | .66 |
| Mathematical Ability | .59 |

SOURCE:   Ref.  [8]

maturation play an important part in the ability to interpret reading material? Does an individual not in school increase his or her ability in factual information, arithmetic skills and interpretive reading at the same rate as an individual in school? Partial answers to these and similar questions can be found by examining the results of tests given to members in the Armed Forces during their stay in 1945 and 1946 at Camp Stoneman, Pittsburg, California. Tests of General Educational Development prepared by the United States Armed Forces Institute were administered to approximately 2,000 soldiers. Each examinee was instructed to state on his answer sheet his age in years as of his last birthday.

Table V shows the mean score and its corresponding percentile for each age group for each of the five tests.

Scores on tests of interpreting reading material in social science, natural science and literature show a definite improvement from one age group to higher age groups. For example, in Test II, Interpretation of Social Science, the 16-year-olds made an average score of 44.2, while the 26 year-olds-and-over made an agerage score of 55.6.

The coefficients of correlations shown in Table V are such as to make any prediction of test score placement by means of age particularly worthless. However, there seems to be a fairly significant increase in the ability to interpret reading material in Social Science, Natural Science and Literature from age 16 to 26, with a smaller increase in the ability in the skills of correct English usage and mathematics. (It should be noted that

# TABLE V.

Mean Scores of Members of Armed Forces in G. E. D.
Tests Grouped According to Ages



| Age | TEST I | | | TEST II | | | TEST III | | | TEST IV | | | TEST V | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Mean Std. Score | Per-cent-ile | No. | Mean Std. Score | Per-cent-ile | No. | Mean Std. Score | Per-cent-ile | No. | Mean Std. Score | Per-cent-ile | No. | Mean Std. Score | Per-cent-ile |

*Coefficient of correlation between test score and age.

SOURCE:  Ref. [9]

different educational accomplishments of the different age

groups may account for the age group differences reported in

Table V.)

E.   PRESENT PRACTICES FOR ISSUING GED CERTIFICATES

The GED tests are given in five parts.  Each section re-

quires approximate-y two hours for completion.  Applicants may

take the tests through the State Department of Education at a

local school, or under the direction of the Education Officer

on a military base.  Veterans eligible for G. I. benefits take

the GED Tests through the United States Veterans Administration.

All scores must be at the 50th percentile or above, to be

considered passing.  Should the applicant not meet the require-

ments, additional private studies may be recommended, or the

local adult educational program or community college may offer

suitable courses.  If evidence of further study can be presented,

the tests may be taken again after six months have elapsed.

The applicant must pass the standardized tests of General

Educational Development with acceptable scores which are no

lower than either:[1]  a.  An average standard score on the five

tests in the battery of not less than 45; or, b. Score of not

less than 35 on any one of the five parts of the GED tests.[Ref.16]

---

[1] However, these are the scores that the Commission has re-
commended for guidance only.  Current state minimum requirements
vary.  Most can be described as either:
     1.   35 or 45
     2.   40 or 45
     3.   35 and 45
     4.   40 and 45

F.  GED STATISTICS

Table VI shows that as the number of GED centers increased over the years, the number of applicants for the tests increased. Also, the average age of applicants has dropped to 25.  However, the percentage of applicants meeting the standards has decreased by about 10 percent since 1954.

In Appendix A, Table V shows the distribution of Educational Accomplishment Groups, Calendar Years 1973 through 1978, entering the services.  The percentage of GED accessions reached 8.0% in some years.  In the Air Force, the percentage of GED's is almost the same as the percentage of nonhighschool graduates.

Table VI (Appendix A) shows the distribution of Army nonprior service GED accessions over the States.  Some States yielded 20-30 percent GED accessions, but some others yielded almost no GED accessions.

Table VII (Appendix A) shows Army accessions, and their distribution by Education, Sex, Race, Age and Mental Category from 1973 to 1978.  It is very interesting to note that the proportion of Blacks is less in the GED groups than in the nonhighschool graduate (NHSG) groups.  Also, GED groups have a greater proportion of accessions in Mental Groups I and II than do the NHS groups.

So far, this thesis has discussed the general problems of the AVF, specifically the attrition problem and the need for new resources to increase the manpower supply.  Then, the thesis explored

TABLE VI

## COMPARATIVE TESTING DATA, 1950-77

| YEAR | Official GED Centers in Operation | Total Volume of Testing | Veterans (%) | Nonveterans (%) | Unclassified (%) | Average Age | Average Number Years of Previous Schooling | Planning Further Study (%) | Percent Meeting Standards |
|---|---|---|---|---|---|---|---|---|---|
| 1950 | 563 | 36,583 | • | • | • | • | • | • | • |
| 1951 | 553 | 25,581 | • | • | • | • | • | • | • |
| 1952 | 557 | 29,733 | • | • | • | • | • | • | • |
| 1953 | 558 | 32,535 | 61.0 | 38.0 | 1.0 | • | • | 59.0 | • |
| 1954 | 571 | 42,141 | 65.0 | 35.0 | • | • | • | • | 80.0 |
| 1955 | 567 | 44,840 | 58.0 | 37.0 | 5.0 | • | • | 46.0 | 79.0 |
| 1956 | 567 | 52,552 | 46.0 | 29.0 | 25.0 | • | • | 43.0 | 77.0 |
| 1957 | 6?? | 52,874 | 49.0 | 35.0 | 16.0 | • | • | 45.0 | 76.0 |
| 1958 | 6?2 | 58,723 | 43.0 | 41.0 | 16.0 | 27.0 | • | 43.0 | 75.0 |
| 1959 | 600 | 56,396 | 37.0 | 45.0 | 18.0 | 28.0 | 10.0 | 36.0 | 76.0 |
| 1960 | 658 | 61,093 | 32.0 | 41.0 | ?.0 | 29.0 | 10.0 | 46.0 | 77.0 |
| 1961 | 702 | 63,090 | 28.0 | 46.0 | 26.0 | 29.0 | 9.9 | 46.0 | 76.0 |
| 1962 | 7?5 | 75,428 | 27.0 | 50.0 | 22.0 | 29.0 | 9.8 | 46.0 | 75.0 |
| 1963 | 80? | 89,242 | 25.0 | 53.0 | 22.0 | 29.0 | 10.0 | 46.0 | 71.0 |
| 1964 | 8?9 | 116,875 | 22.0 | 58.0 | 20.0 | 29.0 | • | • | 74.0 |
| 1965 | 9?? | 133,974 | 19.4 | 53.6 | 22.0 | 29.0 | • | • | 71.0 |
| 1966 | 1031 | 165,776 | 18.7 | 59.7 | 21.5 | 29.3 | • | • | 71.7 |
| 1967 | 1?0? | 216,586 | • | • | • | 29.6 | • | 46.0 | 70.0 |
| 1968 | 1395 | 265,439 | • | • | • | 29.5 | • | 30.0 | 68.? |
| 1969 | 1560 | 293,451 | • | • | • | 29.1 | 9.5 | 47.5 | 71.7 |
| 1970 | 1711 | 331,538 | • | • | • | 20.1 | • | 46.1 | 70.? |
| 1971 | 1??3 | 357,733 | • | • | • | 28.0 | • | 41.? | 68.7 |
| 1972 | 1967 | 400,246 | • | • | • | 27.4 | • | 46.? | 67.4 |
| 1973 | 21?5 | 440,210 | • | • | • | 25.1 | • | 47.0 | 66.2 |
| 1974 | 2421 | 501,203 | • | • | • | 27.2 | 10.7 | 10.6 | 68.9 |
| 1975 | 2?6? | 607,426 | • | • | • | 25.1 | 10.0 | 46.1 | 70.2 |
| 1976 | 2569 | 656,623 | • | • | • | 25.4 | 10.0 | 48.4 | 67.8 |
| 1977 | 2704 | 715,116 | • | • | • | 25.0 | 10.0 | 47.6 | 69.7 |

SOURCE: Ref. [12]

the GED and some of the characteristics of the GED group. But the question remains, "Are GED holders any different from the other groups, such as non-highschool graduates, with respect to first-term attrition?"

1.  Attrition

    If we look at the attrition data in Appendix A, Tables I, II, III, And IV, we see that some groups have higher attrition rates than others.[1] Table VII shows some examples. From 1976 accessions, the Non-Highschool, Mental Group III-B, Non-Negro, Age 20+ group, has a 50 percent loss rate by the end of three years of service. With the same characteristics, except for the GED group instead of the NHS group, the loss rate is 45 percent. If we look at other groups identical except for education, then we see that the GED group has a higher loss rate than does the NHS group. As shown in this example, it is possible to have different results from the comparison of GED and NHS groups when the other characteristics of groups were changed.

    Correlation studies are needed to find out what factors have significant relationships with first-term enlisted attrition. Is having a GED certificate important in terms of attrition rates? There are four different approaches to answering this question. In the next chapter, the different approaches will be examined.

_____

    [1] All attrition data are taken from the Defense Manpower Data Center (DMDC) cohort file.

TABLE VII

THREE YEAR LOSS RATES OF ARMY, CY 1976

ENLISTED NONPRIOR SERVICE ACCESSIONS

| EDUCATION | MENTAL GROUP | AGE | RACE | LOSS RATE |
|-----------|--------------|---------|------------|-----------|
| NHS | III-B | 20+ | Non-Negro | .50 |
| GED | III-B | 20+ | Non-Negro | .45 |
| NHS | IV | 18 & 19 | Negro | .34 |
| GED | IV | 18 & 19 | Negro | .46 |

SOURCE: Analysis made using data from the Defense
Manpower Data Center cohort files.

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# V. PREDICTION

A. COMPARISON OF PREDICTION APPROACHES:

There are two main statistical approaches for attrition prediction purposes, with two variants of each. The main approaches are linear and non-linear in form, with the variants being the use of either individual or grouped observations. [Ref. 4]

The linear approach with individual observations has the disadvantage that it may not be best, especially when the relationship of the predictors to the chances of attriting is not linear. [Ref. 17]

Whereas the individual linear approach uses a binary dependent variable (stay-attrite), the grouped approaches use loss rates (linear) or the log of the odds of loss rates (non-linear) for groups of men defined by all possible combinations of the predictors. An example of a group is recruits with Highschool education, MG III-A, Age 18, and Black.

Both grouped approaches require redefinition or pooling of groups and an additional regression when a predictor variable is found not to be significantly related to the dependent variable. [Ref. 4] Both also require very large samples with even small numbers of predictors. Because of the large number of possible combinations of the predictors, enough men must be found in the groups to produce reliable loss rates. Table VIII compares the approaches.

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TABLE VIII

COMPARISON OF APPROACHES

| Approach | Sample size | No. of variables | Computation | Data fit |
|---|---|---|---|---|
| Linear - individual | Any | Many | 1 stage | Poor |
| - grouped | Large | Fewer | 2 stage | Fair |
| Non-linear - grouped | Large | Fewer | 2 stage | Good |
| - individual | Large | Fewer | Iterative | Best |

SOURCE: Ref.

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B.  GROUPED LINEAR PROBABILITY MODEL

Given the variables thought to influence attrition, then
the goal is to estimate the probability that an individual will
attrite.  Let X = (X1, X2, ....Xk) be the vector of variables
(the characteristics of the individual, such as mental ability and
educational level) thought to affect attrition.

Then with $\underline{n}$ observations on individuals who have been in
military service, of which n1 individuals were attriters and
n2 = n - n1 individuals were non-attriters, an equation can be
estimated giving the probability that an individual with a given
set of characteristics (X vector) will attrite.

The estimated equation may then be used for prediction pur-
poses.  In this model, the individual observations are grouped
into cells on the basis of combinations of the X's, and the depen-
dent variable is the proportion $P = a/n_i$ of the $n_j$ individuals
in the i'th cell who were attriters.  P is an estimate of the
true probability P that individuals with a given set of charac-
teristics will attrite.  The total number of cells is the product
over the number of variables, of the number of intervals for each
variable.  Thus if there are 3 education categories (NHS, GED,
HSDG), 4 mental categories (I&II, III-A, III-B, IV), 3 age cate-
gories (17, 18&19, 20+), and 2 race groups there would be 72 cells.

The main formula for this model is:

$$Y_i = B_0 + B_1X_1 + B_2X_2 + \dots\dots\dots B_kX_k + e \qquad (1)$$

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$Y_1$ is the dependent variable (Probability of attrition $P = a_i/n_i$), X's are the independent variables, $B_0$ is the constant term, and e is the error term.

## C. APPLICATION OF THE MODEL

The main objective of this thesis is to decide whether GED recipients differ in attrition rates from individuals from the other educational groups.

To examine the first-term attrition of GED and other groups, a grouped-linear model was developed using multiple regression techniques.

The predictors in the equation were:

EDUCATION:

    E1..........Non-Highschool

    E2..........G.E.D.

    E3..........Highschool Diploma Graduates

MENTAL CATEGORY:

    M1..........AFQT Category I & II

    M2..........AFQT Category III-A

    M3..........AFQT Category III-B

    M4..........AFQT Category IV

AGE:

    A1..........17

    A2..........18 & 19

    A3..........20+

RACE:

    R1..........Negro

    R2..........Non-negro

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Interaction terms were also used in the equations according to their statistical significance level. For example, interaction terms such as:

$$EM11 = E1 * M1 \qquad or \qquad AR12 = A1 * R2$$

were investigated.

Since binary coding was used in all of our programs, the variables used as reference variables must be shown.

Within the educational accomplishment groups, E3 (HSDG) was chosen as the reference and always coded 0, because this group is the largest (number of people) among the others. The other variables coded as 0 or 1, depending on the case characteristics.

Among the mental ability variables, M3 is the reference variable and always coded as 0. The other mental ability variables were coded as 0's or 1's depending on the case characteristics.

Within the age variables, A2 is the base variable, and, within the race variables, R2 is the base variable for the same reason as above.

An example: For the group characteristics E2(GED), M2 (Mental Group III-A), A1 (Age 17), R2 (Non-negro), the coding is:

| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | Y |
| E1 | E2 | E3 | M1 | M2 | M3 | M4 | A1 | A2 | A3 | R1 | R2 | Y |

Y is the loss rate for that particular group.

Reference variables are subsumed in the intercept of the regression ($B_0$ in Eq. [1]).

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For simplicity, survival of non-prior service (NPS) personnel during the first three years of enlistment was examined. Only Army data were used. There were four years of accession data available for the study: 1973, 1974, 1975 and 1976. In the first regression study, time (years) was used as another variable. The result of this study showed that the year 1973 was different from the other years. The accession cohort entering in 1973 had a lower loss rate than did cohorts from the other years. (See Table IX.) Also it was the first year of AVF experience. It was decided not to use the 1973 data in the other analyses, and data from the other years (1974-1976) were combined.

Since there were three years of attrition data, the validity of the model could be examined. By using the first two years of data (1974, 1975), we could predict the loss rates for the 1976 accessions and compare it with actual loss rates. The prediction equation is in Table IX (Appendix B). The results of this study are in Table X. The differences between the actual and predicted loss rates are very similar to results reported by Lookman. [Ref. 18]

Further, regressions were run with combined 1974, 1975, 1976 data. The results (predictions for 1977 accessions) are shown in Table XI. All computer outputs used are provided in Appendix B. Appendix B also includes a description of the computer program used in the analyses. [Statistical Package for Social Sciences, Ref. 6]

A stepwise regression routine was used which entered the variables in single steps, starting with the variable having the

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TABLE IX

PREDICTION OF ARMY THREE-YEAR LOSS DATA
USING INTERACTIVE VARIABLES

(Data are from 1973-1976 NPS Accessions)

|  |  |
|---|---|
| Multiple R | 0.93521 |
| R Squared | 0.87462 |
| Adjusted R Square | 0.86771 |
| Standard Error | 4.22679 |

VARIABLES IN THE EQUATION

| VARIABLE | B | BETA | STD ERROR B | F |
|---|---|---|---|---|
| E1 | 20.61290 | 0.83762 | 0.73780 | 780.553 |
| E2 | 18.21433 | 0.74016 | 0.86817 | 440.171 |
| M1 | - 6.070351 | -0.22658 | 0.96141 | 39.867 |
| T1 | - 2.201250 | -0.08216 | 0.70446 | 9.764 |
| AE12 | 6.125767 | 0.16595 | 0.95979 | 40.735 |
| AE11 | 5.279048 | 0.14301 | 0.95979 | 30.252 |
| R1 | - 4.774027 | -0.20576 | 0.78762 | 36.740 |
| M2 | - 3.966163 | -0.14804 | 0.88058 | 20.286 |
| AM11 | - 3.869937 | -0.09220 | 1.15755 | 11.177 |
| T2 | 2.664028 | 0.09944 | 0.70446 | 14.301 |
| MR11 | 4.152361 | 0.11838 | 1.22017 | 11.581 |
| T3 | 1.920000 | 0.07167 | 0.70446 | 7.428 |
| MR21 | 2.845417 | 0.08112 | 1.22017 | 5.438 |
| ME41 | - 2.235313 | -0.05326 | 1.05670 | 4.475 |
| ER21 | 2.101667 | 0.06752 | 1.05670 | 3.956 |
| (CONSTANT) | 28.87696 |  |  |  |

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TABLE X

PREDICTED AND ACTUAL THREE YEAR LOSS RATES
FOR ARMY, NPS, 1976 ACCESSIONS

| Education | Mental Gr. | Race | Age | N. of Rec. | Predicted | Actual | Difference |
|-----------|------------|------|-----|------------|-----------|--------|------------|
| E1 | M1 | R2 | A1 | 4409 | 48 | 45 | +3 |
| E1 | M1 | R2 | A3 | 2043 | 46 | 46 | - |
| E1 | M2 | R1 | A1 | 655 | 51 | 50 | +1 |
| E1 | M2 | R1 | A2 | 1287 | 44 | 42 | +2 |
| E1 | M2 | R2 | A2 | 5895 | 48 | 47 | +1 |
| E1 | M3 | R1 | A3 | 2675 | 48 | 45 | +3 |
| E1 | M3 | R2 | A1 | 11384 | 57 | 49 | +3 |
| E1 | M4 | R2 | A3 | 4491 | 51 | 47 | +4 |
| E2 | M1 | R2 | A3 | 860 | 42 | 44 | -2 |
| E2 | M1 | R2 | A2 | 946 | 42 | 42 | - |
| E2 | M1 | R1 | A2 | 69 | 95 | 45 | - |
| E2 | M2 | R1 | A1 | 38 | 50 | 50 | - |
| E2 | M2 | R2 | A1 | 305 | 52 | 50 | +2 |
| E2 | M2 | R2 | A2 | 652 | 99 | 99 | - |
| E2 | M2 | R2 | A3 | 456 | 47 | 48 | -1 |
| E2 | M3 | R2 | A1 | 369 | 55 | 52 | +3 |
| E2 | M3 | R2 | A2 | 766 | 47 | 47 | - |
| E2 | M4 | R1 | A2 | 273 | 46 | 46 | - |
| E2 | M4 | R2 | A2 | 485 | 47 | 47 | - |
| E3 | M1 | R1 | A1 | 201 | 20 | 20 | - |
| E3 | M1 | R2 | A1 | 2071 | 19 | 22 | +3 |
| E3 | M1 | R2 | A3 | 12012 | 23 | 24 | -1 |
| E3 | M2 | R1 | A3 | 1716 | 24 | 27 | -3 |
| E3 | M2 | R2 | A1 | 1233 | 25 | 25 | - |
| E3 | M2 | R1 | A1 | 373 | 22 | 22 | - |
| E3 | M3 | R1 | A2 | 6447 | 25 | 22 | +3 |
| E3 | M3 | R2 | A3 | 5001 | 29 | 33 | +4 |
| E3 | M4 | R1 | A2 | 3464 | 25 | 25 | - |
| E3 | M4 | R2 | A2 | 2869 | 29 | 33 | -4 |

TABLE XI

PREDICTED THREE YEAR LOSS RATES FOR ARMY, NPS, MALE, 1977 ENLISTED ACCESSIONS

| Mental Category | AGE | NHS | | GED | | HSDG | |
|---|---|---|---|---|---|---|---|
| | | NEGRO | NON-NEGRO | NEGRO | NON-NEGRO | NEGRO | NON-NEGRO |
| I & II | 17 | 46.0 | 46.6 | 49.2 | 47.4 | 18.7 | 19.3 |
| | 18-19 | 43.5 | 44.1 | 45.4 | 43.6 | 21.2 | 21.8 |
| | 20+ | 44.5 | 45.1 | 45.1 | 43.3 | 25.2 | 25.8 |
| III-A | 17 | 49 | 53.6 | 49.4 | 51.6 | 21.7 | 26.3 |
| | 18-19 | 44 | 48.6 | 43.1 | 45.3 | 21.7 | 26.3 |
| | 20+ | 45 | 49.6 | 42.8 | 45 | 25.7 | 30.3 |
| III-B | 17 | 51.5 | 56.1 | 51.9 | 54.1 | 24.2 | 28.8 |
| | 18-19 | 46.5 | 51.1 | 45.6 | 47.8 | 24.2 | 28.8 |
| | 20+ | 47.5 | 52.1 | 45.3 | 47.5 | 28.2 | 32.8 |
| IV | 17 | 43 | 53.6 | 51.9 | 51.1 | 24.2 | 28.8 |
| | 18-19 | 38 | 48.6 | 45.6 | 47.8 | 24.2 | 28.8 |
| | 20+ | 39 | 49.6 | 45.3 | 47.5 | 28.2 | 32.8 |

highest correlation with the dependent variable. Other variables entered the equation provided that they met the statistical criterion (explained in the next paragraph). The variable that explains the greatest amount of variance in the dependent variable will enter first, the variable that explains the greatest amount of variance in conjunction with the first will enter second, and so on. In other words, the variable that explains the greatest amount of variance unexplained by the variables already in the equation enters the equation at each step.

Since there were 72*3=216 cases for three years of data, the .05 significance level for F to enter a variable in the equation is 3.8 (Degrees of Freedom changes as more variables entered: 1,214 to 1,200 but the F value is still about the same; 3.8). That means for F 3.8 the null hypothesis B = 0 can be rejected, and the variables included in the equation.

The significant predictors and their F values are shown in Appendix B. An example will now be shown. The main formula was:

$Y = B_0 *  B_1X_1 + \ldots\ldots B_kX_k + e$, where k = 65 in this case and includes interactive variables. For the group (NHS, Mental Cateogry I&II, Non-Negro, Age 17), the significant coefficients are:

$B_0=28.8$   $B_{E1} + 22.3$   $B_{M1} = -7.0$   $B_{R1} = -4.6$   $B_{AE11} = 5.0$

$B_{MR11} = 4.0$   $B_{AM11} = -2.5$

Putting those in the formula yields:

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$$Y = 28.8 + 22.3 + 5.0 + 4.0 - 7.0 - 4.6 - 2.5 = 46.0$$

That means the predicted three-year loss rate for this group is 46 percent. The standard error of estimate was 3.6.

Another regression was run with no interaction variables. The results of this run are shown in Table XII. Similar to other studies, education variables have the highest correlation coefficients. This study also shows that if only education variables were considered, the GED group has lower loss rates than the NHS group.

TABLE XII

PREDICTION OF ARMY THREE YEAR LOSS DATA USING NO
INTERACTIVE PREDICTORS
(DATA ARE FROM 1974-1976 NPS ACCESSIONS)

| MULTIPLE R | 0.95272 | ANALYSIS OF VARIANCE | DF |
|---|---|---|---|
| R SQUARE | 0.90767 | REGRESSION | 8. |
| ADJUSTED R SQUARE | 0.90220 | RESIDUAL | 135. |
| STANDARD ERROR | 3.76652 | | |

| SUM OF SQUARES | MEAN SQUARE | F |
|---|---|---|
| 18828.28318 | 2353.53540 | 165.89788 |
| 1915.19794 | 14.18665 | |

VARIABLES IN THE EQUATION

| VARIABLE | B | BETA | STD ERROR B | F |
|---|---|---|---|---|
| E1 | 24.59646 | 0.96607 | 0.76884 | 1023.473 |
| E2 | 22.47708 | 0.88282 | 0.76884 | 854.695 |
| M1 | - 4.303055 | -0.15525 | 0.88778 | 23.493 |
| A1 | 3.426042 | 0.13456 | 0.76884 | 19.857 |
| M2 | - 2.151667 | -0.07763 | 0.88778 | 5.874 |
| R1 | - 1.950971 | -0.08128 | 0.62775 | 9.659 |
| A3 | 0.9731245 | 0.03822 | 0.76884 | 1.602 |
| M4 | 0.7261102 | 0.02620 | 0.88778 | 0.669 |
| (CONSTANT) | 26.44874 | | | |

## VI.    CONCLUSION AND RECOMMENDATIONS

As can be seen in Table XIII, the three-year loss rates from the Army of the GED group have always been less, other things being equal, than that of the Non-Highschool graduates since the beginning of the AVF.

Highschool graduates, other things being equal, have lower attrition rates than do the other educational accomplishment groups.

In Table XIII, if age is observed, it can be seen that the age 17 group has a much higher loss rate than do the other age groups.  In the same table, mental group I & II have lower loss rates than do the other mental groups, and overall Blacks have lower loss rates than do the non-Blacks.

The predicted loss rates are very similar to the actual group loss data (see Table XI).  In general the GED group's have lower loss rates than do NHS groups.  But for some Negro groups, such as Mental Groups I&II and IV, GED's have higher loss rates than do the NHS groups.  For non-Negros, GED groups always have lower loss rates than do the NHS groups.

The number of GED holders in the market is increasing. (See Table VI.)  During the early 1960's there were about 50 thousand GED certificates issued per year, and now in the late 1970's it is about 500 thousand per year.  Also, the average age of these people is about 24-25, quite available for re-cruiting.

During the 1980's, military services will face difficult recruiting, because of the declining youth population. (See Figure 6.) Within this declining youth population, there will be numerically fewer HSDG's, 17-21 years old. [Ref. 19]

As a result of this study, HSDG's appeared to be the best educational group to have in the services. However, GED certificate holders should in general be preferred to non-highschool graduates, if the Army desires to lower first-term enlisted attrition.

## TABLE XIII

### ACTUAL THREE YEAR LOSS RATES FOR ARMY, NPS, MALE ENLISTEES

| VARIABLES | N | 1973 | N | 1974 | N | 1975 | N | 1976 |
|-----------|-----|------|-----|------|-----|------|-----|------|
| NHS | 67370 | 45 | 80119 | 50 | 61634 | 50 | 56574 | 48 |
| GED | 2680 | 41 | 8641 | 48 | 12996 | 47 | 7597 | 45 |
| HSDG | 91122 | 20 | 76125 | 24 | 87129 | 25 | 88838 | 25 |
| I&II | 48893 | 22 | 40599 | 30 | 44612 | 28 | 47038 | 29 |
| III-A | 36477 | 31 | 38373 | 39 | 40857 | 37 | 34975 | 36 |
| III-B | 49221 | 35 | 53928 | 42 | 58465 | 40 | 67478 | 41 |
| IV | 26631 | 35 | 31985 | 41 | 17825 | 40 | 13518 | 32 |
| 17 | 33512 | 43 | 33984 | 48 | 30926 | 46 | 32328 | 45 |
| 18&19 | 85632 | 28 | 89395 | 36 | 83461 | 34 | 83015 | 32 |
| 20+ | 42007 | 24 | 41484 | 35 | 47344 | 34 | 47663 | 34 |
| Negro | 33715 | 32 | 46250 | 38 | 37545 | 34 | 40691 | 32 |
| Non-Negro | 127457 | 31 | 118635 | 39 | 124214 | 37 | 122318 | 37 |
| TOTAL | 161172 | 31 | 164885 | 39 | 161759 | 36 | 163009 | 36 |

APPENDIX A

TABLE I

ARMY CY 1973 INPUT AND FIRST TERM LOSS DATA FOR 3 YEARS OF NPS MALE RECRUITS

| Mental Grade | AGE | NHSG | | GED | | HSDG | |
|---|---|---|---|---|---|---|---|
| | | Negro | Non-Negro | Negro | Non-Negro | Negro | Non-Negro |
| I & II | 17 | ( 296) 43.92 | (4269) 44.95 | ( 8) 12.50 | (118) 44.07 | (126) 24.60 | (2016) 19.74 |
| | 18-19 | ( 650) 41.08 | (4966) 38.86 | ( 21) 52.38 | (463) 36.07 | (978) 20.86 | (18382) 16.94 |
| | 20+ | ( 260) 40.77 | (1493) 39.05 | ( 27) 33.33 | (309) 42.39 | (743) 22.34 | (13714) 14.79 |
| III-A | 17 | ( 722) 44.88 | (5555) 47.72 | ( 19) 52.63 | ( 90) 44.44 | (243) 18.93 | (1288) 24.46 |
| | 18-19 | (1371) 44.69 | (5841) 43.18 | ( 67) 44.78 | (309) 39.48 | (1900) 22.42 | (10550) 20.23 |
| | 20+ | ( 568) 38.20 | (1474) 43.69 | ( 38) 47.37 | (161) 36.02 | (183) 24.94 | (5096) 18.90 |
| III-B | 17 | (1765) 46.23 | (8929) 50.66 | ( 20) 60.00 | ( 90) 48.89 | (505) 24.95 | (1094) 28.43 |
| | 18-19 | (3382) 42.93 | (9025) 44.99 | (104) 45.19 | (270) 41.85 | (3866) 22.89 | (9566) 22.76 |
| | 20 | (1379) 39.16 | (2376) 42.51 | ( 60) 38.33 | (152) 45.39 | (2477) 26.40 | (4653) 21.99 |
| IV | 17 | (1250) 47.04 | (4480) 50.25 | ( 21) 57.14 | ( 49) 45.45 | (543) 24.31 | ( 521) 37.04 |
| | 18-19 | (2140) 37.01 | (3841) 45.51 | ( 77) 32.47 | (111) 49.55 | (3870) 22.27 | (3882) 25.71 |
| | 20+ | (862) 37.94 | (960 ) 45.63 | ( 44) 43.18 | (57 ) 49.12 | (2124) 25.09 | (1797) 28.44 |

* (....) In parentheses, number of accessions.

APPENDIX A

TABLE II

ARMY CY 1974 INPUT AND FIRST TERM LOSS DATA FOR 3 YEARS OF NPS MALE RECRUITS

| Mental Grade | AGE | NHSG | | GED | | HSDG | |
|---|---|---|---|---|---|---|---|
| | | Negro | Non-Negro | Negro | Non-Negro | Negro | Non-Negro |
| I & II | 17 | (739) 49.93 | (4680) 49.19 | (39) 46.15 | (683) 46.85 | (189) 23.28 | (1941) 20.14 |
| | 18-19 | (1017) 44.64 | (3829) 43.93 | (58) 60.34 | (989) 42.87 | (264) 21.20 | (13716) 19.80 |
| | 20+ | (577) 44.7. | (1213) 50.78 | (62) 46.77 | (599) 46.41 | (934) 27.73 | (8066) 21.83 |
| III-A | 17 | (1341) 53.17 | (7407) 52.54 | (62) 56.45 | (599) 50.92 | (308) 20.13 | (1147) 25.20 |
| | 18-19 | (2083) 48.10 | (5758) 48.68 | (125) 44.80 | (815) 43.93 | (2184) 25.18 | (8267) 24.70 |
| | 20+ | (1142) 47.02 | (1739) 50.03 | (92) 45.65 | (455) 47.47 | (1506) 26.96 | (3337) 27.69 |
| III-B | 17 | (1230) 52.85 | (6684) 56.37 | (182) 58.24 | (1089) 57.21 | (716) 23.88 | (1034) 28.05 |
| | 18-19 | (5291) 48.21 | (11685) 50.69 | (220) 45.45 | (702) 50.28 | (4472) 25.22 | (7836) 27.71 |
| | 20+ | (2644) 45.76 | (3325) 51.91 | (201) 44.28 | (397) 48.87 | (2718) 30.10 | (3491) 30.25 |
| IV | 17 | (515) 56.12 | (1980) 58.79 | (125) 51.20 | (355) 55.49 | (610) 23.28 | (329) 32.52 |
| | 18-19 | (4283) 46.60 | (6669) 53.10 | (225) 46.67 | (266) 96.99 | (4298) 24.24 | (3343) 30.30 |
| | 20+ | (2168) 45.57 | (2105) 53.87 | (129) 48.06 | (171) 38.01 | (2495) 28.54 | (1918) 32.79 |

APPENDIX A

TABLE III

ARMY CY 1975 INPUT AND FIRST TERM LOSS DATA FOR THREE YEARS OF NPS MALE RECRUITS

| Mental Grade | AGE | NHSG Negro | NHSG Non-Negro | GED Negro | GED Non-Negro | HSDG Negro | HSDG Non-Negro |
|---|---|---|---|---|---|---|---|
| I & II | 17 | ( 318)50.63 | (3527)49.02 | ( 43)39.53 | (1099)49.77 | ( 178)19.66 | ( 2293)19.89 |
|  | 18-19 | ( 379)46.70 | (3086)41.70 | ( 63)41.27 | (1519)44.31 | (1038)19.17 | (15526)19.74 |
|  | 20+ | ( 261)48.66 | (1175)46.13 | ( 82)48.78 | (1066)42.31 | (1089)22.96 | (11864)23.02 |
| III-A | 17 | ( 868)48.50 | (7082)52.06 | ( 77)54.55 | (1092)50.73 | ( 338)18.05 | ( 1321)26.27 |
|  | 18-19 | (1261)46.39 | (5254)45.44 | (142)41.55 | (1287)46.00 | (2235)20.81 | ( 9742)24.71 |
|  | 20+ | ( 733)48.02 | (1904)48.42 | (130)43.08 | ( 761)46.91 | (1792)26.90 | ( 4829)29.24 |
| III-B | 17 | (1068)53.56 | (5235)55.53 | (299)51.17 | (1718)57.16 | ( 789)21.67 | ( 1156)28.63 |
|  | 18-19 | (4372)48.86 | (11760)51.54 | (294)46.60 | (1167)45.42 | (5200)23.21 | ( 9216)28.49 |
|  | 20+ | (2333)46.76 | (3986)52.81 | (251)39.84 | ( 718)49.30 | (3746)26.70 | ( 5149)31.60 |
| IV | 17 | ( 302)55.63 | (1053)57.93 | (122)52.46 | ( 291)59.11 | ( 375)24.53 | ( 282)27.66 |
|  | 18-19 | (1531)48.92 | (2477)56.84 | (185)51.89 | ( 289)45.33 | (2815)24.72 | ( 2623)32.41 |
|  | 20+ | (762) 46.72 | (886) 54.18 | (118)41.53 | ( 181)45.36 | (1948)29.11 | ( 1580)34.49 |

TABLE IV

ARMY CY 1976 INPUT AND FIRST TERM LOSS DATA FOR 3 YEARS OF NPS MALE RECRUITS

| Mental Grade | AGE | NHS | | GED | | HSDG | |
|---|---|---|---|---|---|---|---|
| | | Negro | Non-Negro | Negro | Non-Negro | Negro | Non-Negro |
| I & II | 17 | (353) 40.79 | (4409) 45.02 | (19) 42.11 | (388) 47.42 | (201) 20.40 | (2071) 22.0 |
| | 18-19 | (652) 40.49 | (4720) 40.00 | (69) 44.93 | (946) 42.49 | (1319) 17.13 | (15018) 20.2 |
| | 20+ | (392) 39.03 | (2043) 46.94 | (89) 47.19 | (860) 44.53 | (1475) 24.47 | (12012) 24.3 |
| III-A | 17 | (655) 49.92 | (5057) 50.46 | (38) 50.00 | (305) 50.16 | (373) 22.52 | (1233) 25.63 |
| | 18-19 | (1287) 42.42 | (5395) 47.32 | (99) 38.38 | (652) 44.63 | (2335) 20.90 | (8586) 24.61 |
| | 20+ | (695) 42.01 | (2004) 46.96 | (98) 37.76 | (456) 48.25 | (1716) 27.56 | (3991) 31.70 |
| III-B | 17 | (2302) 49.83 | (11384) 54.59 | (95) 53.68 | (369) 52.53 | (870) 21.72 | (1187) 32.43 |
| | 18-19 | (4782) 44.35 | (12272) 49.27 | (272) 39.71 | (766) 47.13 | (6447) 22.68 | (9705) 28.37 |
| | 20+ | (2675) 45.42 | (4491) 50.12 | (212) 41.51 | (510) 45.69 | (4137) 29.08 | (5001) 33.71 |
| IV | 17 | (46) 28.26 | (163) 47.85 | (33) 48.48 | (90) 50.00 | (408) 25.74 | (279) 28.67 |
| | 18-19 | (228) 34.65 | (374) 41.44 | (273) 46.89 | (485) 47.63 | (3464) 25.03 | (2869) 33.67 |
| | 20+ | (74) 36.49 | (119) 47.06 | (194) 50.52 | (279) 50.90 | (2313) 29.79 | (1827) 36.12 |

APPENDIX A

TABLE V

EDUCATIONAL DISTRIBUTION OF NPS MALE ENLISTEES, WITHIN THE SERVICE

| ENTERING YEAR | TOTAL NUMBER OF ACC. | % GED | % NHS | % HSDG |
|---|---|---|---|---|
| | | ARMY | | |
| 1973 | 161,172 | .017 | .418 | .565 |
| 1974 | 164,885 | .052 | .485 | .461 |
| 1975 | 161,759 | .080 | .381 | .538 |
| 1976 | 163,009 | .046 | .408 | .544 |
| 1977 | 148,631 | .028 | .399 | .572 |
| 1978 | 104,824 | .036 | .268 | .695 |
| | | NAVY | | |
| 1973 | 88,665 | * | .308 | .692 |
| 1974 | 83,070 | * | .337 | .662 |
| 1975 | 89,433 | * | .283 | .716 |
| 1976 | 79,298 | .041 | .206 | .752 |
| 1977 | 81,664 | .044 | .219 | .736 |
| 1978 | 59,026 | .060 | .200 | .739 |
| | | AIR FORCE | | |
| 1973 | 85.612 | .027 | .135 | .837 |
| 1974 | 64,203 | .083 | .070 | .895 |
| 1975 | 63,486 | .060 | .079 | .860 |
| 1976 | 62,630 | .046 | .066 | .887 |
| 1977 | 60,533 | .031 | .045 | .923 |
| 1978 | 54,057 | .073 | .072 | .854 |

* Included in NHS

APPENDIX A

TABLE VI

DISTRIBUTION OF THE ARMY, NPS, GED CERTIFICATE HOLDERS OVER THE STATES, 1973 - 1978
MALE & FEMALE

| STATES | 1973 | | 1974 | | 1975 | | 1976 | | 1977 | | 1978 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | #NPS Acc. | %GED | #NPS Acc. | %GED | #NPS Acc. | %GED | #NPS Acc. | %GED | #NPS Acc. | %GED | #NPS Acc. | %GED |
| Alabama | 4501 | .021 | 4958 | .057 | 3856 | .113 | 3569 | .093 | 4793 | .040 | 3297 | .044 |
| Alaska | 284 | .038 | 213 | .192 | 171 | .280 | 128 | .085 | 214 | .158 | 123 | .138 |
| American Samoa | 2 | – | 346 | – | 195 | – | 176 | .017 | 188 | .010 | 113 | .008 |
| Arizona | 1653 | .038 | 2074 | .100 | 2245 | .187 | 2191 | .098 | 2743 | .010 | 1518 | .096 |
| Arkansas | 2125 | .024 | 2424 | .060 | 2170 | .061 | 2075 | .031 | 2105 | .021 | 1522 | .024 |
| California | 16136 | .028 | 18194 | .076 | 17789 | .078 | 17607 | .048 | 19000 | .036 | 9735 | .034 |
| Canal Zone | 4 | – | 3 | – | 5 | – | 35 | .057 | 33 | .030 | 20 | – |
| Colorado | 1739 | .033 | 2370 | .054 | 2389 | .115 | 2397 | .070 | 2350 | .057 | 1376 | .059 |
| Connecticut | 1151 | .017 | 1352 | .043 | 1861 | .053 | 2056 | .017 | 2797 | .015 | 1142 | .023 |
| Delaware | 334 | .017 | 428 | .024 | 495 | .038 | 524 | .028 | 759 | .021 | 468 | .025 |
| Dist. Columbia | 469 | .019 | 685 | .119 | 758 | .180 | 664 | .115 | 989 | .041 | 558 | .041 |
| Florida | 7051 | .014 | 7960 | .025 | 7707 | .051 | 7505 | .040 | 10618 | .023 | 7502 | .029 |
| Georgia | 5436 | .014 | 6067 | .039 | 5422 | .085 | 5002 | .063 | 6657 | .027 | 4819 | .030 |
| Guam | 102 | .029 | 261 | .026 | 284 | .042 | 308 | .055 | 454 | .061 | 345 | .023 |
| Hawaii | 724 | .007 | 940 | .014 | 797 | .028 | 707 | .008 | 1031 | .010 | 673 | .023 |
| Idaho | 768 | .017 | 819 | .035 | 827 | .077 | 767 | .062 | 700 | .092 | 316 | .022 |
| Illinois | 7074 | .016 | 6358 | .039 | 7138 | .044 | 7770 | .020 | 9820 | .022 | 5053 | .023 |
| Indiana | 4077 | .014 | 3825 | .047 | 4454 | .069 | 4818 | .028 | 5303 | .030 | 2625 | .025 |
| Iowa | 2653 | .017 | 2198 | .057 | 2085 | .110 | 2285 | .049 | 2431 | .090 | 1268 | .057 |
| Kansas | 1636 | .033 | 1768 | .128 | 1672 | .172 | 1558 | .089 | 1723 | .037 | 811 | .050 |
| Kentucky | 3611 | .021 | 3415 | .094 | 2850 | .154 | 2980 | .053 | 3707 | .040 | 2101 | .052 |
| Louisiana | 3449 | .014 | 3708 | .075 | 2880 | .053 | 2548 | .059 | 3181 | .091 | 1973 | .055 |
| Maine | 860 | .024 | 939 | .079 | 953 | .117 | 1002 | .059 | 1332 | .041 | 795 | .075 |
| Maryland | 7560 | .023 | 2735 | .058 | 4506 | .061 | 3162 | .027 | 4341 | .019 | 2616 | .025 |
| Massachusetts | 3000 | .015 | 2718 | .039 | 3717 | .045 | 3534 | .034 | 4640 | .020 | 2544 | .032 |
| Michigan | 5976 | .201 | 7440 | .081 | 8567 | .086 | 8277 | .046 | 9098 | .035 | 4159 | .043 |
| Minnesota | 3425 | .008 | 2732 | .029 | 3341 | .077 | 2898 | .070 | 3414 | .038 | 1749 | .046 |
| Mississippi | 2309 | .013 | 3156 | .025 | 2401 | .052 | 2273 | .067 | 3110 | .073 | 1879 | .056 |
| Missouri | 3910 | .010 | 3533 | .036 | 3790 | .050 | 3980 | .031 | 5020 | .028 | 2486 | .025 |
| Montana | 760 | .025 | 779 | .051 | 696 | .087 | 743 | .068 | 711 | .059 | 328 | .054 |
| Nebraska | 1167 | .014 | 1113 | .085 | 1010 | .126 | 1236 | .084 | 1146 | .073 | 703 | .064 |

TABLE VI (Continued)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nevada | 416 | .028 | 524 | .120 | 499 | .144 | 482 | .080 | 521 | .051 | 277 | .054 |
| New Hampshire | 559 | .030 | 728 | .125 | 819 | .134 | 845 | .079 | 1039 | .038 | 575 | .073 |
| New Jersey | 3721 | .016 | 3525 | .058 | 4825 | .048 | 4709 | .026 | 6043 | .019 | 2802 | .039 |
| New Mexico | 1065 | .050 | 1563 | .106 | 1216 | .202 | 1138 | .134 | 1369 | .078 | 802 | .098 |
| New York | 9616 | .021 | 9317 | .050 | 11470 | .056 | 12244 | .039 | 16415 | .021 | 7787 | .034 |
| N. Carolina | 6883 | .015 | 8707 | .029 | 5974 | .015 | 5482 | .037 | 7425 | .021 | 5409 | .020 |
| N. Dakota | 734 | .015 | 599 | .036 | 573 | .045 | 405 | .034 | 453 | .015 | 339 | .029 |
| Ohio | 7960 | .007 | 6646 | .016 | 8271 | .027 | 9802 | .011 | 12244 | .007 | 6687 | .010 |
| Oklahoma | 2439 | .022 | 2550 | .032 | 2571 | .071 | 2270 | .047 | 2309 | .046 | 1211 | .046 |
| Oregon | 2420 | .032 | 2785 | .095 | 2553 | .094 | 2562 | .045 | 2178 | .056 | 1033 | .039 |
| Pennsylvania | 7201 | .017 | 6732 | .042 | 8368 | .053 | 8926 | .039 | 10838 | .028 | 5614 | .034 |
| Puerto Rico | 2339 | .012 | 2778 | .039 | 2229 | .070 | 2208 | .062 | 2841 | .047 | 2776 | .047 |
| Rhode Island | 493 | .032 | 514 | .114 | 730 | .153 | 674 | .059 | 881 | .031 | 514 | .091 |
| S. Carolina | 3230 | .009 | 3802 | .008 | 2771 | .023 | 2574 | .029 | 3825 | .011 | 2921 | .009 |
| S. Dakota | 624 | .022 | 621 | .008 | 669 | .005 | 478 | .121 | 595 | .075 | 310 | .077 |
| Tennessee | 3898 | .023 | 4416 | .053 | 3671 | .105 | 3910 | .054 | 4886 | .027 | 2874 | .026 |
| Texas | 10961 | .003 | 12971 | .124 | 11768 | .221 | 10265 | .131 | 11171 | .088 | 6323 | .048 |
| Utah | 911 | .008 | 899 | .057 | 951 | .086 | 829 | .043 | 557 | .025 | 306 | .042 |
| Vermont | 349 | .010 | 365 | .095 | 418 | .098 | 453 | .050 | 564 | .028 | 334 | .047 |
| Virginia | 4638 | .014 | 5376 | .067 | 4786 | .072 | 4912 | .031 | 6113 | .021 | 3857 | .014 |
| Virgin Islands | 87 | .022 | 109 | .045 | 111 | .027 | 134 | .044 | 255 | .047 | 197 | .020 |
| Washington | 3956 | .030 | 3968 | .070 | 3671 | .112 | 3378 | .050 | 3721 | .044 | 1591 | .042 |
| West Virginia | 2078 | .024 | 1817 | .150 | 1723 | .298 | 1550 | .110 | 1633 | .091 | 1061 | .073 |
| Wisconsin | 3635 | .014 | 2700 | .036 | 3310 | .064 | 3447 | .053 | 4180 | .035 | 1969 | .037 |
| Wyoming | 279 | .025 | 299 | .053 | 232 | .120 | 235 | .106 | 257 | .097 | 118 | .084 |
| Total # NPS Access. | 169,433 | | 179,842 | | 180,109 | | 178,887 | | 216,859 | | 122,397 | |
| Total # of GED | 3507 | | 10,643 | | 15,084 | | 9,045 | | 7,481 | | 4,379 | |

TABLE VII

EDUCATIONAL GROUPS ASSOCIATED WITH SEX, RACE, AGE, MENTAL GROUP
AND THE ACCESSION YEARS WITHIN THE ARMY

| TOTAL # OF NPS ACC. | Sex | | Race | | Age | | | Mental Group | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Negro | Non-Negro | 17 | 18&19 | 20+ | I & II | III-A | III-B | IV |
| **NHS** | | | | | | | | | | | |
| Acc. Years: | | | | | | | | | | | |
| 1973 67,381 | 100 | --- | .22 | .78 | .40 | .46 | .14 | .18 | .23 | .39 | .20 |
| 1974 80,118 | 100 | --- | .29 | .71 | .31 | .51 | .18 | .15 | .24 | .39 | .22 |
| 1975 61,635 | 100 | --- | .23 | .77 | .31 | .49 | .20 | .14 | .28 | .47 | .11 |
| 1976 66,808 | 100 | --- | .21 | .79 | .36 | .45 | .19 | .19 | .23 | .57 | .01 |
| 1977 77,602 | 100 | --- | .25 | .75 | .39 | .42 | .19 | .13 | .20 | .65 | .02 |
| 1978 28,592 | 100 | --- | .28 | .72 | .23 | .54 | .22 | .14 | .31 | .52 | .02 |
| **GED** | | | | | | | | | | | |
| 1973 3,507 | .76 | .24 | .18 | .82 | .12 | .53 | .35 | .40 | .30 | .20 | .10 |
| 1974 10,643 | .81 | .19 | .17 | .83 | .29 | .42 | .29 | .36 | .26 | .26 | .12 |
| 1975 15,084 | .86 | .14 | .14 | .86 | .31 | .40 | .29 | .35 | .28 | .30 | .08 |
| 1976 9,045 | .84 | .16 | .19 | .81 | .15 | .47 | .38 | .36 | .23 | .26 | .15 |
| 1977 7,481 | .77 | .23 | .22 | .78 | .14 | .42 | .44 | .35 | .23 | .27 | .15 |
| 1978 4,379 | .86 | .14 | .21 | .79 | .12 | .43 | .45 | .29 | .29 | .39 | .02 |

## TABLE VIII

COMPUTER PROGRAM FOR THE PREDICTION OF LOSS RATES OF THE ARMY
1977, NPS, MALE ACCESSIONS

```
1 RUN NAME        MULTIPLE REGRESSION ;
2 VARIABLE LIST   E1,E2,E3,M1,M2,M3,M4,A1,A2,A3,R1,R2,T1,Tw,T3,Tr,Y,N
3 INPUT MEDIUM    CARD
4 N of CASES      216
5 INPUT FORMAT    FIXED (16F1.0,F5.2,F5.0)
6ALLOCATE         TRANSPACE = 5500
7  COMPUTE        AE11=A1*E1
8  COMPUTE        AE12=A1*E2
9  COMPUTE        AE13=A1*E3
10 COMPUTE        AE21=A2*E1
11 COMPUTE        AE22=A2*E2
12COMPUTE         AE23=A2*E3
13 COMPUTE        AE31=A3*E1
14 COMPUTE        AE32=A3*E2
15 COMPUTE        AE33=A3*E3
16 COMPUTE        ME11=M1*E1
17 COMPUTE        ME12=M1*E2
18 COMPUTE        ME13=M1*E3
19 COMPUTE        ME21=M2*E1
20 COMPUTE        ME22=M2*E2
21 COMPUTE        ME23=M2*E3
22 COMPUTE        ME31=M3*E1
23 COMPUTE        ME32=M3*E2
24 COMPUTE        ME33=M3*E3
25 COMPUTE        ME41=M4*E1
26 COMPUTE        ME42=M4*E2
27 COMPUTE        ME43=M4*E3
28 COMPUTE        AM11=A1*M1
29 COMPUTE        AM12=A1*M2
30 COMPUTE        AM13=A1*M3
31 COMPUTE        AM14=A1*M4
32 COMPUTE        AM21=A2*M1
33 COMPUTE        AM22=A2*M2
34 COMPUTE        AM23=A2*M3
35 COMPUTE        AM24=A2*M4
36 COMPUTE        AM31=A3*M1
37 COMPUTE        AM32=A3*M2
38 COMPUTE        AM33=A3*M3
39 COMPUTE        AM34=A3*Mr
40 COMPUTE        AR11=A1*R1
41 COMPUTE        AR12=A1*R2
42 COMPUTE        AR21=A2*R1
43 COMPUTE        AR22=A2*R2
44 COMPUTE        AR31=A3*R1
45 COMPUTE        AR32=A3*R2
46 COMPUTE        ER11=E1*R1
47 COMPUTE        ER12=E1*R2
```

## TABLE VIII
### (Continued)

```
48 COMPUTE        ER21=E2*R1
49 COMPUTE        ER22=E2*R2
50 COMPUTE        ER31=E3*R1
51 COMPUTE        ER32=E3*R2
52 COMPUTE        MR11=M1*R1
53 COMPUTE        MR12=M1*R2
54 COMPUTE        MR21=M2*R1
55 COMPUTE        MR22=M2*R2
56 COMPUTE        MR31=M3*R1
57 COMPUTE        MR32=M3*R2
58 COMPUTE        MR41=M4*R1
59 COMPUTE        MR42=M4*R2
60 VAR LABELS     Y RESPONSE VARIABLE/
61                E1 NGH
62                E2 GED
63                E3 HSDG
64                M1 AFQT 1&2
65                M2 AFQT 3-A
66                M3 AFQT 3-B
67                M4AFQT 4
68                A1 AGE 17
69                A2 AGE 18&19
70                A3 AGE 20+
71                R1 NEGRO
72                R2 NON-NEGRO
73                T1 1973 ACC.
74                T2 1974 ACC.
75                T3 1975 ACC.
76                T4 1976 ACC.
77 REGRESSION     VARIABLES =E1 TO MR42
78                REGRESSION=Y WITH E1,#2,#3,M1,M2,M3,M4,A1,A2,A3,R1,R2
79                AE11 to MR42(1) RESID=0
80 STATISTICS     1,2,6

81 READ INPUT DATA
```

APPENDIX B

TABLE IX

PREDICTION OF ARMY THREE YEAR LOSS DATA USING INTERACTIVE
VARIABLES (DATA ARE FROM 1974-1975 NPS ACCESSIONS)

| SUM OF SQUARES | MEAN SQUARE | F |
|---|---|---|
| 19524.00941 | 1774.90995 | 192.12263 |
| 1219.47171 | 9.23842 | |

VARIABLES IN THE EQUATION

| VARIABLE | B | BETA | STD ERROR B | F |
|---|---|---|---|---|
| E1 | 22.58315 | 0.88699 | 0.70273 | 1032.741 |
| E2 | 18.73523 | 0.73586 | 0.88461 | 448.556 |
| AE12 | 7.833362 | 0.20511 | 0.98998 | 62.610 |
| M1 | -5.500838 | -0.19846 | 0.93937 | 34.291 |
| AE11 | 6.039926 | 0.15815 | 0.98998 | 37.223 |
| M2 | -3.353793 | -0.12100 | 0.72111 | 21.631 |
| R1 | -3.807338 | -0.15861 | 0.68591 | 30.811 |
| MR11 | 4.410186 | 0.12152 | 1.16990 | 14.211 |
| AM11 | -4.111097 | -0.09467 | 1.18234 | 12.090 |
| AM32 | 2.517212 | 0.05797 | 1.10253 | 5.213 |
| ER21 | 2.261460 | 0.07022 | 1.07462 | 4.429 |
| (CONSTANT) | 29.20637 | | | |

| | | | | |
|---|---|---|---|---|
| MULTIPLE R | | 0.97016 | ANALYSIS OF VARIANCE | DF |
| R SQUARE | | 0.94121 | REGRESSION | 11. |
| ADJUSTED R SQUARE | | 0.93631 | RESIDUAL | 132. |
| STANDARD ERROR | | 3.03948 | | |

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APPENDIX B

TABLE X

PREDICTION OF ARMY THREE YEAR LOSS DATA USING INTERACTIVE VARI-
ABLES (DATA ARE FROM 1974-1976 NPS ACCESSIONS)

VARIABLES IN THE EQUATION

| VARIABLE | B | BETA | STD ERROR B | F |
|---|---|---|---|---|
| E1 | 22.34372 | 0.91418 | 0.95610 | 546.141 |
| E2 | 19.09398 | 0.78122 | 1.10082 | 300.858 |
| M1 | -7.058958 | -0.26529 | 1.02901 | 47.059 |
| AE12 | 6.280727 | 0.17132 | 1.07707 | 33.381 |
| R1 | -4.597330 | -0.19951 | 0.66862 | 47.277 |
| AE11 | 5.086144 | 0.13873 | 1.08707 | 21.891 |
| MR11 | 4.070987 | 0.11685 | 1.14040 | 12.743 |
| M2 | -2.546241 | -0.09569 | 0.63000 | 16.335 |
| A3 | 3.995470 | 0.16347 | 0.91874 | 18.913 |
| AM11 | -2.559573 | -0.06140 | 1.16213 | 4.851 |
| AE32 | -4.269220 | -0.11645 | 1.39334 | 9.388 |
| ER21 | 2.459028 | 0.07954 | 1.04753 | 5.511 |
| AE31 | -3.010886 | -0.08213 | 1.39334 | 4.670 |
| ME41 | -2.544670 | -0.06104 | 1.05861 | 5.778 |
| ME12 | 2.821241 | 0.06768 | 1.22268 | 5.327 |
| (CONSTANT) | 28.80770 | | | |

| | | ANALYSIS OF VARIANCE | DF |
|---|---|---|---|
| MULTIPLE R | 0.95297 | | |
| R SQUARE | 0.90816 | REGRESSION | 15 |
| ADJUSTED R SQUARE | 0.90127 | RESIDUAL | 200 |

| SUM OF SQUARES | MEAN SQUARE | F |
|---|---|---|
| 26040.41152 | 1736.02743 | 131.83952 |
| 2633.54635 | 13.16773 | |

DESCRIPTION OF THE VARIABLES:
| | | | |
|---|---|---|---|
| E1=NHS | R1=NEGRO | A3= 20+ | AE31=A3*E1 |
| E2=GED | AE11=A1*E1 | AM11=A1*M1 | ME41=M4*E1 |
| M1=I&II | MR11=M1*R1 | AE32=A3*E2 | ME12=M1*E2 |
| AE12=A1*E2 | M2=III-A | ER21=E2*R1 | M4=IV |
| A1=17 | | | |

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